unoccupied night time periods during winter weather. If any internal load, such as lighting, contributes to building heating, such loads shall be accounted for in assessing heating performance.

10.3.9.3 Energy use measurements shall be made for the overall building system while HVAC system performance is being tested. Each energy management and control system shall be used to determine energy use for:

10.3.9.3.1 Utility energy;

10.3.9.3.2 Commercial service energy:

10.3.9.3.3 Occupant lighting and receptacle power;

10.3.9.3.4 Production process energy;

10.3.9.3.5 Auxiliary systems and service water heating energy;

10.3.9.3.6 Space heating energy;

10.3.9.3.7 Space cooling energy; and

10.3.9.3.8 HVAC delivery system energy.

10.3.9.3.9 Test periods shall be at least six (6) hours in duration. Hourly outdoor and indoor temperatures, solar intensity during a day test, and wind speed during a night test shall be recorded.

10.3.9.4 The building energy performance test data shall, at minimum, measure energy use and outdoor temperatures hourly for each test period.

10.3.10 Documentation Data Requirements

10.3.10.1 As-built information shall be provided for all the following energy-related features of the building:

10.3.10.1.1 Thermal and solar/optical transmission characteristics of the building envelope, including infiltration;

10.3.10.1.2 The operating characteristics of the HVAC, lighting, and service water heating equipment and systems;

10.3.10.1.3 Internal heat gain contributed by equipment and processes; and

10.3.10.1.4 The operating characteristics of controls.

10.3.10.2 A summary report shall be provided outlining the design basis data for the building envelope, the internal heat gains, the weather extremes, major heating/cooling equipment sizes and sequence of operation.

10.3.10.3 The construction documents shall require that shop drawings, schematic diagrams, control sequence, maintenance manuals, and operating instructions, with data on all HVAC, auxiliary equipment and service water heating systems be provided to the owner.

10.3.10.4 A system balancing report shall be provided that follows National Environmental Balancing Bureau or the Association of Air Balancing Council formats with an extra section summarizing the energy-related values gathered during balancing.

10.3.10.5 An energy performance test report shall be provided showing all the data gathered during the energy performance tests. The results shall be presented in a format that provides convenient comparison with design values.

§ 435.111 Building energy cost compliance alternative.

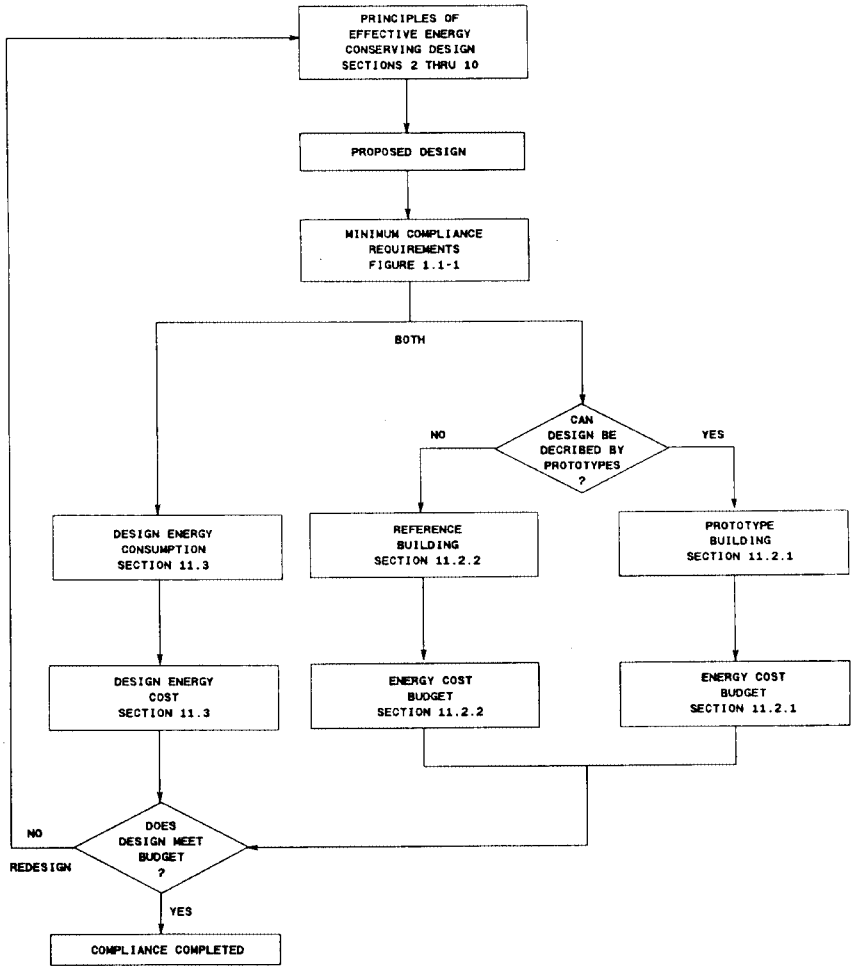
11.1 General

11.1.1 This section provides an alternative compliance path that allows greater flexibility in the design of energy efficient buildings using an annual energy cost method. Energy cost is used as the common denominator in determining compliance. Using unit costs rather than units of energy or power such as Btu, kWh or kW allows the energy use contribution of different fuel sources at different times to be added and compared. This path allows for innovation in designs, materials, and equipment, such as daylighting, passive solar heating, heat recovery, better zonal temperature control, thermal storage, and other applications of off-peak electrical energy, that cannot be adequately evaluated by the prescriptive or system performance alternatives found in sections 3.4, 3.5, 5.4, 5.5, and 7.4. This compliance path is intended for design comparisons only and is not intended to be used to either predict, document, or verify annual energy consumption or annual energy costs.

11.1.2 The Building Energy Cost Compliance Alternative is to be used in lieu of the prescriptive or system performance methods and in conjunction with the minimum requirements found in sections 3.3, 4.3, 5.3, 6.3, 7.3, 8.3, 9.3 and 10.3.

11.1.3 *Compliance.* Compliance under this method requires detailed energy analyses of the entire Proposed Design, referred to as the Design Energy Consumption; an estimate of annual energy cost for the proposed design, referred to as the Design Energy Cost; and comparison against an Energy Cost Budget. Compliance is achieved when the estimated Design Energy Cost is less than or equal to the Energy Cost Budget (see Figure 11–1). This section provides instructions for determining the Energy Cost Budget and for calculating the Design Energy Consumption and Design Energy Cost. The Energy Cost Budget shall be determined through the calculation of monthly energy consumption and energy cost of a Prototype or Reference Building design configured to meet the requirements of sections 3.0 through 10.0.

Figure 11-1 Building Energy Cost Compliance Alternative



11.1.4 Designers are encouraged to employ the Building Energy Cost Budget compliance method set forth in this section for evaluating proposed design alternatives in preference to using the prescriptive/system methods. The Building Energy Cost Budget establishes the relative effectiveness of each design alternative in energy cost savings, providing an energy cost basis upon which the building owner and designer may select one design over another. This Energy Cost Budget is the highest allowable calculated Energy Cost Budget for a specific building design. Other alternative designs are likely to have lower annual energy costs and life cycle costs than those that minimally meet the Energy Cost Budget.

11.1.5 The Energy Cost Budget is a numerical target for annual energy cost. It is intended to assure neutrality with respect to choices of HVAC system type, architectural design, fuel choice, etc., by providing a fixed, repeatable budget target that is independent of any of these choices wherever possible (i.e., for the prototype buildings). The Energy Cost Budget for a given building size and type will vary only with climate, the number of stories, and the choice of simulation tool. The specifications of the prototypes are necessary to assure repeatability, but have no other significance. They are not recommended energy conserving practice, or even physically reasonable practice for some climates or buildings, but represent a reasonable worst case of energy cost resulting from compliance with the spirit and the letter of sections 3.0 through 10.0.

11.2 Determination of the Annual Energy Cost Budget

11.2.1 The annual Energy Cost Budgets shall be determined in accordance with the Prototype Building Method in section 11.2.5, or the Reference Building Method in section 11.2.5. Both methods calculate an annual Energy Cost by summing the 12 monthly Energy Cost Budgets. Each monthly Energy Cost Budget is the product of the monthly Building Energy Consumption of each type of energy used multiplied by the monthly Energy Cost per unit of energy for each type of energy used.

11.2.2 The Energy Cost Budget shall be determined in accordance with Equation 11–1 as follows:

$$ECB=ECB_{jan}+ \ldots ECB_{m}+ \ldots +ECB_{dec}$$

Equation 11–1

Based on:

$$ECB_{m}=BECON_{m1}\times ECOS_{m1}+ \ldots +BECON_{mi} \times ECOS_{mi}$$

Equation 11–2

Where:

ECB=The annual Energy Cost Budget
ECB_{m}=The monthly Energy Cost Budget
$BECON_{mi}$=The monthly Budget Energy Consumption of the i^{th} type of energy
$ECOS_{mi}$=The monthly Energy Cost, per unit of the i^{th} type of energy

11.2.3 The monthly Energy Cost Budget shall be determined using current rate schedules or contract prices available at the building site for all non-depletable types of energy purchased. These costs shall include demand charges, rate blocks, time of use rates, interruptable service rates, delivery charges, taxes, and all other applicable rates for the type, location, operation, and size of the proposed design. The monthly Budget Energy Consumption shall be calculated from the first day through the last day of each month, inclusive.

11.2.4 The Energy Cost Budget, Design Energy Consumption and Design Energy Cost calculations are applicable only for determining compliance with these standards. They are not predictions of actual energy consumption or costs of the proposed building after construction. Actual experience will differ from these calculations due to variations such as occupancy, building operation and maintenance, weather, energy use not covered by these standards, changes in energy rates between design of the building and occupancy, and precision of the calculation tool.

11.2.5 Prototype Building Procedure

11.2.5.1 The Prototype Building procedure shall be used for all building types listed below. For mixed-use buildings the Energy Cost Budget is derived by allocating the floor space of each building type within the floor space of the prototype building. For buildings not listed below, the Reference Building procedure of section 11.2.5 shall be used.

11.2.5.1.1 Prototype buildings include:

(a) Assembly;
(b) Office (Business);
(c) Retail (Mercantile);
(d) Warehouse (Storage);
(e) School (Educational);
(f) Hotel/Motel;
(g) Restaurant;
(h) Health/Institutional; and
(i) Multi-Family.

11.2.5.2 Use of the Prototype Building to Determine the Energy Cost Budget

11.2.5.2.1 Determine the building type of the Proposed Design using the categories in section 11.2.5.1. Using the appropriate Prototype Building characteristics from Tables 11–1 through 11–8,

the building shall be simulated using the same gross floor area and number of floors for the Prototype Building as in the Proposed Design.

11.2.5.2.3 The form, orientation, occupancy and use profiles for the Prototype Building shall be fixed as described in section 11.5.3. Envelope, lighting, other internal loads and HVAC systems and equipment shall meet the prescriptive or system requirements of section 3.0 through 10.0 and are standardized inputs.

11.2.6 Reference Building Method

11.2.6.1 The Reference Building procedure shall be used only when the Proposed Design cannot be represented by one or a combination of the Prototype Building listed in section 11.2.5.1 or the assumptions for the Prototype Building in section 11.5, such as occupancy and use-profiles, do not reasonably represent the Proposed Design.

11.2.6.2 Use of the Reference Building to Determine the Energy Cost Budget

11.2.6.2.1 Each floor shall be oriented in the same manner for the Reference Building as in the Proposed Design. The form, gross and conditioned floor areas of each floor and the number of floors shall be the same as in the Proposed Design. All other characteristics, such as lighting, envelope and HVAC systems and equipment, shall meet the prescriptive/system requirements of section 3.0 through 10.0.

11.2.7 Calculation Procedure and Simulation Tool

11.2.7.1 The Prototype or Reference Buildings shall be modeled using the criteria of section 11.5 and section 11.6. The modeling shall use a climate data set appropriate for both the site and the complexity of the energy conserving features of the design. ASHRAE Weather Year for Energy Calculations (WYEC) data or bin weather data shall be a default choice.

11.3 Determination of the Design Energy Consumption and Design Energy Cost

11.3.1 The Design Energy Consumption shall be calculated by modeling the Proposed Design using the same methods, assumptions, climate data, and simulation tool as were used to establish the Energy Cost Budget, except as explicitly stated in 11.5. The Design Energy Cost shall be calculated per Equation 11–3. If the Proposed Design includes cogeneration or non-depletable energy sources designed for the sale of energy off-site, then energy cost and income resulting from outside sales shall not be used to reduce the Design Energy Costs. Such systems shall be modeled as operating to supply energy needs of the Proposed Design only.

$$DECOS = DECOS_{jan} + \ldots DECOS_{m} \ldots + DECOS_{dec} \quad \ldots .$$

Equation 11–3

Based on:

$$DECOS_{m} = DECON_{m1} \times ECOS_{m1} + \ldots + DECON_{mi} \times ECOS_{mi} \quad \ldots$$

Equation 11–4

Where:

DECOS=The annual Design Energy Cost

$DECOS_m$=The monthly Design Energy Cost

$ICON_{mi}$=The monthly Design Energy Consumption of the i^{th} type of energy

$ECOS_{mi}$=The monthly Energy Cost per unit of the i^{th} type of energy

The $DECON_{mi}$ shall be calculated from the first day through the last day of the month, inclusive.

11.4 Compliance

11.4.1 If the Design Energy Cost is less than or equal to the Energy Cost Budget, and all of the minimum requirements of sections 3.0 through 10.0 are met, the Proposed Design complies with the standards.

11.5 Standard Calculation Procedure

11.5.1 The Standard Calculation Procedure consists of methods and assumptions for calculating the Energy Cost Budget for the Prototype or Reference Building and the Design Energy Consumption and Design Energy Cost of the Proposed Design. In order to maintain consistency between the Energy Cost Budget and the Design Energy Cost, the input assumptions to be used are stated below. These inputs shall be used to determine the Energy Cost Budget and the Design Energy Consumption.

11.5.2 Prescribed assumptions shall be used without variation. Default assumptions shall be used unless the designer can demonstrate that a different assumption better characterizes the building's energy use over its expected life. No modified default assumptions shall be used in modeling both the Prototype or Reference Building and the Proposed Design unless the designer demonstrates clear cause to do otherwise. Special procedures for speculative buildings are discussed in section 11.5.9. Shell buildings may not use section 11.0.

11.5.3 Orientation and Shape

11.5.3.1 The Prototype Building shall consist of the same number of stories, and gross and conditioned floor area as the Proposed Design, with equal area per story. The building shape shall be rectangular, with a 2.5:1 aspect ratio. The long dimensions of the building shall face East and West. This is intended to provide an energy budget that can be met even if there are unfavorable site constraints. The fenestration shall be uniformly distributed in proportion to exterior wall area.

11.5.3.2 Floor-to-floor height for the Prototype Building shall be 13 ft except for dwelling units in hotels/motels and multi-family high rise residential buildings where floor-to-floor height shall be 9.5 ft.

11.5.3.3 The Reference Building shall consist of the same number of stories, and gross floor area for each story as the Proposed Design. Each floor shall be oriented in the same manner as the Proposed Design. The geometric form shall be the same as the Proposed Design.

11.5.4 Internal Loads

11.5.4.1 The systems and types of energy specified in this section are intended only as constraints in calculating the Energy Cost Budget. They are not intended as either requirements or recommendations for either systems or the type of energy to be used in the Proposed Design or for calculation of Design Energy Cost.

11.5.4.2 Internal loads for multi-family high rise residential buildings are presented in Table 11–1. These assumptions shall be prescribed assumptions. Internal loads for other building types shall be modeled as noted in this subsection.

11.5.4.2.1 Occupancy

(a) Occupancy schedules shall be Default Assumptions. The same assumptions shall be made in computing Design Energy Consumption as were used in calculating the Energy Cost Budget.

(b) Table 11–2, Occupancy Density, establishes the density, in ft^2/person of conditioned floor area, to be used for each building type. Table 11–3, Building Schedule Percentage Multipliers, establishes the percentage of total occupants in the building by hour of the day for each building type.

11.5.4.2.2 Lighting

(a) Interior Lighting Power Allowance (ILPA), for calculating the Energy Cost Budget shall be determined from section 3.0. The lighting power used to calculate the Design Energy Consumption shall be the actual adjusted power for lighting in the Proposed Design. If the lighting controls in the Proposed Design are more effective at saving energy than those required by section 3.3, the actual installed lighting power shall be used along with the schedules reflecting the action of the controls to calculate the Design Energy Consumption. This actual installed lighting power shall not be adjusted by the Power Adjustment Factors listed in Table 3.5–2.

(b) Lighting energy profiles are shown in Table 11–3 that establish the percentage of the lighting load switched-on in each Prototype or Reference Building by hour of the day. These profiles are default assumptions and can be changed when calculating the Energy Cost Budget to provide, for example, a 12 hour rather than an 8 hour work day.

11.5.4.2.3 Receptacles

(a) Receptacle loads and profiles are default assumptions. The same assumptions shall be made in calculating Design Energy Consumption as were used in calculating the Energy Cost Budget.

(b) Receptacle loads include all general service loads that are typical in a

building. These loads exclude any process electrical usage and HVAC primary or auxiliary electrical usage. Table 11–4, Receptacle Power Densities, establishes the density, in W/ft^2, to be used for each building type. The receptacle energy profiles shall be the same as the lighting energy profiles in Table 11–3. This profile establishes the percentage of the receptacle load that is switched on by hour of the day and by building type.

11.5.5 Building Exterior Envelope

11.5.5.1 Insulation and Glazing

11.5.5.1.1 The insulation and glazing characteristics of the Prototype and Reference Building envelope shall be determined by using the first column under ''Base Case'', with no assumed overhangs for the appropriate Alternate Component Tables (ACP) in section 5.0, as defined by climate range. The insulation and glazing characteristics from this ACP are Prescribed Assumptions for Prototype and Reference Buildings for calculating the Energy Cost Budget. In calculating the Design Energy Consumption of the Proposed Design, the envelope characteristics of the Proposed Design shall be used.

11.5.5.2 Infiltration

11.5.5.2.1 For Prototype and Reference Buildings, infiltration assumptions shall be prescribed assumptions for calculating the Energy Cost Budget and default assumptions for the Design Energy Consumption. Infiltration shall impact perimeter zones only.

11.5.5.2.2 When the HVAC system is switched ''on'', no infiltration shall be assumed. When the HVAC system is switched ''off'', the infiltration rate for buildings with or without operable windows shall be assumed to be 0.038 cfm/ft^2 of gross exterior wall. Hotels/motels and multi-family high rise residential buildings shall have infiltration rates of 0.038 cfm/ft^2 of gross exterior wall area at all times.

11.5.5.3 Envelope and Ground Absorptivities

11.5.5.3.1 For Prototype and Reference Buildings, absorptivity assumptions shall be prescribed assumptions for computing the Energy Cost Budget and default assumptions for computing the Design Energy Consumption. The solar absorptivity of opaque elements of the building envelope is assumed to be 70%. The solar absorptivity of ground surfaces is assumed to be 80% (20% reflectivity).

11.5.5.4 Window Management

11.5.5.4.1 For the Prototype and Reference Building, window management drapery assumptions shall be prescribed assumptions for setting the Energy Cost Budget. No draperies shall be the default assumption for computing the Design Energy Consumption. Glazing is assumed to be internally shaded by medium-weight draperies, closed one-half time. The draperies shall be modeled by assuming that one-half the area in each zone is draped and one-half is not. If manually-operated draperies, shades, or blinds are to be used in the Proposed Design, the Design Energy Consumption shall be calculated by assuming they are effective over one-half the glazing area in each zone.

11.5.5.5 Shading

11.5.5.5.1 For Prototype and Reference buildings and the Proposed Design, shading by permanent structures, terrain, and vegetation shall be taken into account for computing energy consumption, whether or not these features are located on the building site. A permanent fixture is one that is likely to remain for the life of the Proposed Design.

11.5.6 HVAC Systems and Equipment

11.5.6.1 The specifications and requirements for the HVAC systems of the Prototype and Reference Buildings shall be those in Table 11–5, HVAC Systems for Prototype and Reference Buildings. For the calculation of the Design Energy Consumption, the HVAC systems and equipment of the Proposed Design shall be used.

11.5.6.2 The systems and types of energy presented in Table 11–5 are intended only as constraints in calculating the Energy Cost Budget. They are not intended as either requirements or recommendations for either systems or the type of energy to be

used in the Proposed Building or for the calculation of the Design Energy Cost.

11.5.6.3 HVAC Zones

11.5.6.3.1 HVAC zones for calculating the Energy Cost Budget of the Prototype or Reference Building shall consist of at least four perimeter and one interior zones per floor. Prototype Buildings shall have one perimeter zone facing each cardinal direction. The perimeter zones of Prototype and Reference Buildings shall be 15 ft in width, or one-third the narrow dimension of the building, when this dimension is between 30 ft and 45 ft inclusive, or one-half the narrow dimension of the building when this dimension is less than 30 ft. Zoning requirements shall be a default assumption for calculating the Energy Cost Budget. For multi-family high rise residential buildings, the prototype building shall have one zone per dwelling unit. The proposed design shall have one zone per unit unless zonal thermostatic controls are provided within units; in this case, two zones per unit shall be modeled. Building types such as assembly or warehouse may be modeled as a single zone if there is only one space.

11.5.6.3.2 For calculating the Design Energy Consumption, no fewer zones shall be used than were in the Prototype and Reference Buildings. The zones in the simulation shall correspond to the zones provided by the controls in the Proposed Design. Thermally similar zones, such as those facing one orientation on different floors, may be grouped together for the purposes of either the Design Energy Consumption or Energy Cost Budget simulation.

11.5.6.4 Equipment Sizing and Redundant Equipment

11.5.6.4.1 For calculating the Energy Cost Budget of Prototype or Reference Buildings, HVAC equipment shall be sized to meet the requirements of section 7.3.2, without using any of the exceptions. The size of equipment shall be that required for the building without process loads considered. The designer shall determine the final equipment sizing including the process loads by separate calculations. Redundant and/or emergency equipment need not be simulated if it is controlled so that it will not be operated during normal operations of the building. The designer shall document the installation of process equipment and the size of process loads.

11.5.6.4.2 For calculating the Design Energy Consumption, actual air flow rates and installed equipment size shall be used in the simulation, except that excess capacity provided to meet process loads need not be modeled if the process load was not modeled in setting Energy Cost Budget. Equipment sizing in the simulation of the Proposed Design shall correspond to the equipment actually selected for the design and the designer shall not use equipment sized automatically by the simulation tool.

11.5.6.4.3 Redundant and/or emergency equipment need not be simulated if it is controlled to not be operated during normal operations of the building.

11.5.7 Service Water Heating

11.5.7.1 The service water loads for Prototype and Reference Buildings are defined in terms of Btu/h per person in Table 11–6. The service water heating loads from Table 11–6 are prescribed assumptions for multi-family high rise residential buildings and default assumptions for all other buildings. The same service water heating load assumptions shall be made in calculating Design Energy Consumption as were used in calculating the Energy Cost Budget.

11.5.7.2 The service water heating system, including piping losses for the Prototype Building, shall be modeled using the methods of the *ASHRAE Handbook, 1987 HVAC Systems and Applications Volume* using a system that meets all requirements of section 9.0. The service water heating equipment for the Prototype or Reference Building shall be either natural gas or #2 fuel oil, if natural gas is not available at the site, or an electric heat pump.

11.5.7.3 *Exception to section 11.5.7:*

11.5.7.3.1 If electric resistance service water heating is preferable to an electric heat pump when analyzed according to the criteria of section 9.3.7.1

or when service water temperatures exceeding 145 °F are required for a particular application, electric resistance water heating may be used.

11.5.8 Controls

11.5.8.1 All occupied conditioned spaces in the Prototype, Reference and Proposed Design Buildings in all climates shall be simulated as being both heated and cooled. The assumptions in this subsection are prescribed assumptions. If the Proposed Design does not include equipment for cooling or heating, the Design Energy Consumption shall be determined by the specifications for calculating the Energy Cost Budget as described in Table 11–7.

11.5.8.2 *Exceptions to section 11.5.8:*

11.5.8.2.1 If a building is to be provided with only heating or cooling, both the Prototype or Reference Building and the Proposed Design shall be simulated, using the same assumptions. If such an assumption is made, the analysis shall show that the building interior temperature meets the comfort criteria of *ANSI/ASHRAE 55–1981* ''Thermal Environmental Conditions for Human Occupancy,'' at least 98% of the occupied hours during the year.

11.5.8.2.2 If warehouses are not intended to be mechanically cooled, both the Energy Cost Budget and Design Energy Consumption shall be modeled assuming no mechanical cooling; and

11.5.8.2.3 In climates where winter design temperature (97.5% occurrence) is greater than 59 °F, space heating need not be modeled.

11.5.8.3 Space temperature controls for the Prototype or Reference Building, except multi-family high rise residential buildings shall be set at 70 °F for space heating and 75 °F for space cooling with a deadband per section 7.3.4.5. The system shut off during off-hours shall be according to the schedule in Table 11–3, except that the heating system shall cycle on if any space should drop below the night setback setting of 55 °F. There shall be no similar setpoint during the cooling season. Lesser deadband ranges may be used in calculating the Design Energy Consumption.

11.5.8.3.1 *Exceptions to section 11.5.8.3:*

(a) Setback shall not be modeled in determining either the Energy Cost Budget or Design Energy Cost if setback is not realistic for the Proposed Design, such as 24 hour/day operations. Health facilities need not have night setback during the heating season;

(b) Hotel/motels and multi-family high rise residential buildings shall have a night setback temperature of 60 °F from 11:00 p.m. to 6:00 a.m. during the heating season; and

(c) If deadband controls are not to be installed, the Design Energy Cost shall be calculated with both heating and cooling thermostat setpoints set to the same value between 70 °F and 75 °F inclusive, assumed to be constant for the year.

11.5.8.3.2 For multi-family buildings, the thermostat schedule for the dwelling units shall be as in Table 11–8.

(a) The Prototype Building shall use the single zone schedule. The Proposed Design shall use the two-zone schedule only if zonal thermostatic controls are provided. For Proposed Designs that use heat pumps employing supplementary heat, the controls used to switch on the auxiliary heat source during morning warm-up periods shall be simulated accurately. The thermostat assumptions for multi-family high-rise buildings are prescribed assumptions.

11.5.8.4 When providing for outdoor air ventilation in calculating the Energy Cost Budget, controls shall be assumed to close the outside air intake to reduce the flow of outside air to 0 cfm during setback and unoccupied periods. Ventilation using inside air may still be required to maintain scheduled setback temperature. Outside air ventilation, during occupied periods, shall be as required by *ASHRAE Standard 62–1981,* ''Ventilation for Acceptable Indoor Air,'' or the Proposed Design, whichever is greater.

11.5.8.5 If humidification is to be used in the Proposed Design, the same level of humidification and system type shall be used in the Prototype or Reference Building. If dehumidification requires subcooling of supply air, then reheat for the Prototype or Reference Building shall be from recovered waste heat such as condenser waste heat.

11.5.9 Speculative Buildings

11.5.9.1 Lighting

11.5.9.1.1 The interior lighting power allowance (ILPA) for calculating the Energy Cost Budget shall be determined from Table 3.4–1. The Design Energy Consumption may be based on an assumed adjusted lighting power for future lighting improvements.

(a) The assumption about future lighting power used to calculate the Design Energy Consumption must be documented so that the future installed lighting systems may be in compliance with these standards. Documentation must be provided to enable future lighting systems to use either the Prescriptive method of section 3.4 or the Systems Performance method of section 3.5.

(b) Documentation for future lighting systems that use the Prescriptive method of section 3.4 shall be stated as a maximum adjusted lighting power for the tenant spaces. The adjusted lighting power allowance for tenant spaces shall account for the lighting power provided for the common areas of the building.

(c) Documentation for future lighting systems that use the System Performance method of section 3.5 shall be stated as a required lighting adjustment. The required lighting adjustment is the whole building lighting power assumed in order to calculate the Design Energy Consumption minus the ILPA value from Table 3.4–1 that was used to calculate the Energy Cost Budget. When the required lighting adjustment is less than zero, a complete lighting design must be developed for one or more representative tenant spaces, demonstrating acceptable lighting within the limits of the assumed lighting power allowance.

11.5.9.2 HVAC Systems and Equipment

11.5.9.2.1 If the HVAC system is not completely specified in the plans, the Design Energy Consumption shall be based on reasonable assumptions about the construction of future HVAC systems and equipment. These assumptions shall be documented so that future HVAC systems and equipment may be in compliance with these standards.

11.6 The Simulation Tool

11.6.1 Annual energy consumption shall be simulated with a multi-zone, 8760 hours per year building energy model. The model shall account for:

11.6.1.1 The dynamic heat transfer of the building envelope such as solar and internal gains;

11.6.1.2 Equipment efficiencies as a function of load and climate;

11.6.1.3 Lighting and HVAC system controls and distribution systems by simulating the whole building;

11.6.1.4 The operating schedule of the building including night setback during various times of the year; and

11.6.1.5 Energy consumption information at a level necessary to determine the Energy Cost Budget and Design Energy Cost through the appropriate utility rate schedules.

11.6.2 While the simulation tool should simulate an entire year on an hour by hour basis (8760 hours), programs that approximate this dynamic analysis procedure and provide equivalent results are acceptable.

11.6.3 Simulation tools shall be selected for their ability to simulate accurately the relevant features of the building in question, as shown in the tool's documentation. For example, a single zone model shall not be used to simulate a large, multi-zone building, and a steady-state model such as the degree-day method shall not be used to simulate buildings when equipment efficiency or performance is significantly affected by the dynamic patterns of weather, solar radiation, and occupancy. Relevant energy-related features shall be addressed by a model such as daylighting, atriums or sunspaces, night ventilation or thermal storage, chilled water storage or heat recovery, active or passive solar systems, zoning and controls of heating and cooling systems, and ground-coupled buildings. In addition, models shall be capable of translating the Design Energy Consumption into energy cost using actual utility rate schedules with the coincidental electrical demand of a building. Examples of public domain models capable of handling such complex building systems and energy cost translations available in the United States are DOE–2.1C and

BLAST 3.0 and in Canada, Energy Systems Analysis Series.

11.6.4 All simulation tools shall use scientifically justifiable documented techniques and procedures for modeling building loads, systems, and equipment. The algorithms used in the program shall have been verified by comparison with experimental measurements, loads, systems, and equipment.

TABLE 11-1

MULTI-FAMILY HIGH RISE RESIDENTIAL BUILDING SCHEDULES

(INTERNAL LOADS PER DWELLING UNIT Btu/h)

One-Zone Dwelling Unit

	OCCUPANTS		LIGHTS	EQUIPMENT	
HOUR	SENSIBLE	LATENT	SENSIBLE	SENSIBLE	LATENT
1	300	260	0	750	110
2	300	260	0	750	110
3	300	260	0	750	110
4	300	260	0	750	110
5	300	260	0	750	110
6	300	260	0	750	110
7	300	260	980	1250	190
8	210	200	840	2600	420
9	100	80	0	1170	180
10	100	80	0	1270	190
11	100	80	0	1270	190
12	100	80	0	2210	330
13	100	80	0	2210	330
14	100	80	0	1270	190
15	100	80	0	1270	190
16	100	80	0	1270	190
17	100	80	0	1270	190
18	300	260	0	3040	450
19	300	260	0	3360	500
20	300	260	960	1490	220
21	300	260	960	1490	220
22	300	260	960	1490	220
23	300	260	960	1060	160
24	300	260	960	1060	160

TABLE 11-1 (CONT.)
MULTI-FAMILY HIGH RISE RESIDENTIAL BUILDING SCHEDULES
(INTERNAL LOADS PER DWELLING UNIT Btu/h)

Two-Zone Dwelling Unit

HOUR	BEDROOMS & BATHROOMS					OTHER ROOMS				
	OCCUPANTS		LIGHTS	EQUIPMENT		OCCUPANTS		LIGHTS	EQUIPMENT	
	Sensible	Latent	Sensible	Sensible	Latent	Sensible	Latent	Sensible	Sensible	Latent
1	300	260	0	100	20	0	0	0	650	90
2	300	260	0	100	20	0	0	0	650	90
3	300	260	0	100	20	0	0	0	650	90
4	300	260	0	100	20	0	0	0	650	90
5	300	260	0	100	20	0	0	0	650	90
6	300	260	0	100	20	0	0	0	650	90
7	200	180	680	200	40	100	80	300	1050	150
8	110	120	240	200	40	100	80	600	2400	380
9	0	0	0	100	20	100	80	0	1070	160
10	0	0	0	100	20	100	80	0	1170	170
11	0	0	0	100	20	100	80	0	1170	170
12	0	0	0	100	20	100	80	0	2110	310
13	0	0	0	100	20	100	80	0	2110	310
14	0	0	0	100	20	100	80	0	1170	170
15	0	0	0	100	20	100	80	0	1170	170
16	0	0	0	100	20	100	80	0	1170	170
17	0	0	0	100	20	100	80	0	1170	170
18	0	0	0	100	20	300	260	0	2940	430
19	0	0	0	100	20	300	260	0	3260	480
20	100	80	320	300	60	200	180	640	1190	160
21	100	80	320	300	60	200	180	640	1190	160
22	150	130	480	700	90	150	130	480	790	130
23	300	260	640	410	70	0	0	320	650	90
24	300	260	640	410	70	0	0	320	650	90

TABLE 11-2
OCCUPANCY DENSITY

BUILDING TYPE	CONDITIONED FLOOR AREA Ft^2/PERSON
Assembly	50
Office	275
Retail	300
Warehouse	15000
School	75
Hotel/Motel	250
Restaurant	100
Health/Institutional	200
Multi-family High Rise Residential	2 per unit[1]

Heat generation: Btu/h per person: 230 Btu/h per person sensible, and 190 Btu/h per person latent.

1. See Table 11-1

TABLE 11-3
BUILDING SCHEDULE PERCENTAGE MULTIPLIERS

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
ASSEMBLY OCCUPANCY	WEEKDAY:	0	0	0	0	0	0	0	0	20	20	20	20	80	80	80	80	80	80	20	20	20	20	10	0
	SATURDAY:	0	0	0	0	0	0	0	0	20	20	20	20	60	60	60	60	60	60	60	60	60	80	10	0
	SUNDAY:	0	0	0	0	0	0	0	0	10	10	10	10	10	70	70	70	70	70	70	70	70	70	20	0
ASSEMBLY LTNG & RECEP	WEEKDAY:	0	0	0	0	0	0	40	40	40	75	75	75	75	75	75	75	75	75	75	75	75	75	25	0
	SATURDAY:	0	0	0	0	0	0	0	30	30	50	50	50	50	50	50	50	50	50	50	50	50	50	0	0
	SUNDAY:	0	0	0	0	0	0	0	30	30	30	30	30	65	65	65	65	65	65	65	65	65	65	0	0
ASSEMBLY HVAC	WEEKDAY:	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF
	SATURDAY:	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF
	SUNDAY:	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF
ASSEMBLY SWH	WEEKDAY:	0	0	0	0	0	0	0	0	0	5	5	35	5	5	5	5	5	0	0	0	0	0	0	0
	SATURDAY:	0	0	0	0	0	0	0	0	0	5	5	20	0	0	0	0	0	0	0	65	30	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	5	5	10	0	0	0	0	0	0	0	65	30	0	0	0
OFFICE OCCUPANCY	WEEKDAY:	0	0	0	0	0	0	0	10	20	95	95	45	45	95	95	95	95	95	30	10	10	10	0	0
	SATURDAY:	0	0	0	0	0	0	0	10	10	30	30	30	30	10	10	10	10	10	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OFFICE LTNG & RECEP	WEEKDAY:	0	0	0	0	0	0	10	30	90	90	90	90	80	90	90	90	90	90	30	30	20	20	0	0
	SATURDAY:	0	0	0	0	0	0	10	10	30	30	30	30	15	15	15	15	15	15	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OFFICE HVAC	WEEKDAY:	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
	SATURDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	SUNDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
OFFICE SWH	WEEKDAY:	0	0	0	0	0	0	0	15	30	35	35	45	55	50	30	30	40	20	20	10	15	5	0	0
	SATURDAY:	0	0	0	0	0	0	0	10	10	20	15	20	15	15	10	10	10	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 11-3 (Continued)
BUILDING SCHEDULE PERCENTAGE MULTIPLIERS

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RETAIL	WEEKDAY:	0	0	0	0	0	0	0	10	20	50	50	70	70	70	70	80	70	50	50	30	30	0	0	0
OCCUPANCY	SATURDAY:	0	0	0	0	0	0	0	10	20	50	60	80	80	80	80	80	80	60	20	20	20	10	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	10	20	20	40	40	40	40	40	20	10	0	0	0	0	0
RETAIL	WEEKDAY:	0	0	0	0	0	0	0	20	50	90	90	90	90	90	90	90	90	90	60	60	50	0	0	0
LTNG & RECEP	SATURDAY:	0	0	0	0	0	0	0	10	30	60	90	90	90	90	90	90	90	90	50	30	30	10	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	10	40	40	60	60	60	60	60	40	20	0	0	0	0	0
RETAIL	WEEKDAY:	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF
HVAC	SATURDAY:	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF
	SUNDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
RETAIL	WEEKDAY:	0	0	0	0	0	0	0	10	20	30	40	55	60	60	45	40	45	45	40	30	30	0	0	0
SWH	SATURDAY:	0	0	0	0	0	0	0	15	20	25	40	50	55	55	45	45	45	45	40	35	25	20	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	10	25	30	35	35	30	30	35	30	20	0	0	0	0	0
WAREHOUSE	WEEKDAY:	0	0	0	0	0	0	0	15	70	90	90	90	50	85	85	85	20	0	0	0	0	0	0	0
OCCUPANCY	SATURDAY:	0	0	0	0	0	0	0	0	20	20	20	20	10	10	10	10	0	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WAREHOUSE	WEEKDAY:	0	0	0	0	0	0	0	40	70	90	90	90	90	90	90	90	90	0	0	0	0	0	0	0
LTNG & RECEP	SATURDAY:	0	0	0	0	0	0	0	0	10	25	25	25	10	10	10	10	0	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WAREHOUSE	WEEKDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
HVAC	SATURDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	SUNDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
WAREHOUSE	WEEKDAY:	0	0	0	0	0	0	0	5	25	35	35	45	55	50	35	50	15	0	0	0	0	0	0	0
SWH	SATURDAY:	0	0	0	0	0	0	0	0	0	10	10	15	0	0	0	0	0	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 11-3 (Continued)
BUILDING SCHEDULE PERCENTAGE MULTIPLIERS

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
SCHOOL	WEEKDAY:	0	0	0	0	0	0	0	5	75	90	90	80	80	80	80	45	15	5	15	20	20	10	0	0
OCCUPANCY	SATURDAY:	0	0	0	0	0	0	0	0	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCHOOL	WEEKDAY:	0	0	0	0	0	0	0	30	85	95	95	95	80	80	80	70	50	50	35	35	35	30	0	0
LTNG & RECEP	SATURDAY:	0	0	0	0	0	0	0	0	15	15	15	15	15	0	0	0	0	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCHOOL	WEEKDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
HVAC	SATURDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	SUNDAY:	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
SCHOOL	WEEKDAY:	0	0	0	0	0	0	0	5	30	55	60	70	75	80	60	60	5	5	15	20	20	20	0	0
SWH	SATURDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOTEL/MOTEL	WEEKDAY:	90	90	90	90	90	90	70	40	40	20	20	20	20	20	20	30	50	50	50	70	70	80	90	90
OCCUPANCY	SATURDAY:	90	90	90	90	90	90	70	50	50	30	30	30	30	30	30	30	30	50	60	60	60	70	70	70
	SUNDAY:	70	70	70	70	70	70	70	70	50	50	50	30	30	20	20	20	30	40	40	60	60	80	80	80
HOTEL/MOTEL	WEEKDAY:	20	15	10	10	10	20	40	50	40	40	25	25	25	25	25	25	25	25	60	80	90	80	60	30
LTNG & RECEP	SATURDAY:	20	20	10	10	10	10	30	30	40	40	30	25	25	25	25	25	25	25	60	70	70	70	60	30
	SUNDAY:	30	30	20	20	20	20	30	40	40	30	30	30	30	20	20	20	20	20	50	70	80	60	50	30
HOTEL/MOTEL	WEEKDAY:	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
HVAC	SATURDAY:	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
	SUNDAY:	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
HOTEL/MOTEL	WEEKDAY:	20	15	15	15	20	25	50	60	55	45	40	45	40	35	30	30	30	40	55	60	50	55	45	25
SWH	SATURDAY:	20	15	15	15	20	25	40	50	50	50	45	50	50	45	40	40	34	40	55	55	50	55	40	30
	SUNDAY:	25	20	20	20	20	30	50	50	50	55	50	50	40	40	30	30	30	40	50	50	40	50	40	20

TABLE 11-3 (Continued)
BUILDING SCHEDULE PERCENTAGE MULTIPLIERS

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RESTAURANT	WEEKDAY:	15	15	5	0	0	0	0	5	5	5	20	50	80	70	40	20	25	50	80	80	80	50	35	20
OCCUPANCY	SATURDAY:	30	25	5	0	0	0	0	0	0	5	20	45	50	50	35	30	30	30	70	90	70	65	55	35
	SUNDAY:	20	20	5	0	0	0	0	0	0	0	0	20	25	25	15	20	25	35	55	65	70	35	20	20
RESTAURANT	WEEKDAY:	15	15	15	15	15	20	40	40	60	60	90	90	90	90	90	90	90	90	90	90	90	90	50	30
LTNG & RECEP	SATURDAY:	20	15	15	15	15	15	30	30	60	60	80	80	80	80	80	80	80	90	90	90	90	90	50	30
	SUNDAY:	20	15	15	15	15	15	30	30	50	70	70	70	70	70	70	70	60	60	60	60	60	60	50	30
RESTAURANT	WEEKDAY:	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
HVAC	SATURDAY:	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
	SUNDAY:	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
RESTAURANT	WEEKDAY:	20	15	15	0	0	0	0	60	55	45	40	45	40	35	30	30	30	40	55	60	50	55	45	25
SWH	SATURDAY:	20	15	15	0	0	0	0	0	0	50	45	50	50	45	40	40	35	40	55	55	50	55	40	30
	SUNDAY:	25	20	20	0	0	0	0	0	0	0	50	50	40	40	30	30	30	40	50	50	40	50	40	20
HEALTH	WEEKDAY:	0	0	0	0	0	0	0	10	50	80	80	80	80	80	80	80	80	50	30	30	20	20	0	0
OCCUPANCY	SATURDAY:	0	0	0	0	0	0	0	10	30	40	40	40	40	40	40	40	40	10	10	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	5	5	5	5	5	5	5	5	5	0	0	0	0	0	0	0
HEALTH	WEEKDAY:	0	0	0	0	0	0	0	50	90	90	90	90	90	90	90	90	90	30	30	30	30	30	0	0
LTNG & RECEP	SATURDAY:	0	0	0	0	0	0	0	20	40	40	40	40	40	40	40	40	40	10	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	10	10	10	10	10	10	10	10	0	0	0	0	0	0	0	0
HEALTH	WEEKDAY:	0	0	0	0	0	0	0	15	55	65	75	80	70	80	75	70	60	40	15	15	15	5	0	0
SWH	SATURDAY:	0	0	0	0	0	0	0	0	15	25	25	25	20	20	20	20	20	5	0	0	0	0	0	0
	SUNDAY:	0	0	0	0	0	0	0	0	0	15	15	15	15	15	15	0	0	0	0	0	0	0	0	0
HEALTH	WEEKDAY:	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
HVAC	SATURDAY:	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
	SUNDAY:	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
MULTI-FAMILY	WEEKDAY:	0	0	0	5	5	5	80	70	50	40	20	20	25	25	50	50	70	70	35	20	15	15	5	0
SWH SYSTEM	SATURDAY:	0	0	0	0	0	0	20	45	50	50	35	30	30	30	70	90	70	65	55	35	30	25	5	0
	SUNDAY:	0	0	0	0	0	0	0	20	25	25	15	20	25	35	55	65	70	35	20	20	20	20	5	0

NOTES FOR TABLE 11-3

1 Reference: Recommendations for Energy Conservation Standards and Guidelines for New Commercial Buildings, Vol. III, App. A Pacific Northwest Laboratory, PNL-4870-8, 1983."

2 Table 11-3 contains multipliers for converting the nominal values for building occupancy (Table 11-2), receptacle power density (Table 11-4), service hot water (Table 11-6), and lighting energy (Section 3.4 or 3.5) into time series data for estimating building loads under the Standard Calculation Procedure.

For each standard building profile there are three series - one each for weekdays, Saturday and Sunday. There are 24 elements per series. These represent the multiplier that should be used to estimate building loads from 12 a.m. to 1 a.m. (series element #1) through 11 p.m. to 12 a.m. (series element #24). The estimated load for any hour is simply the multiplier from the appropriate standard profile multiplied by the appropriate value from the tables cited above.

3 The Building HVAC System Schedule listed in Table 11-3 lists the hours when the HVAC system shall be considered "on" or "off" in accordance with Section 11.5.5.2.

TABLE 11-4
RECEPTACLE POWER DENSITIES

BUILDING TYPE	W/ft^2 OF CONDTIONED FLOOR AREA
Assembly	0.25
Office	0.75
Retail	0.25
Warehouse	0.1
School	0.5
Hotel/Motel	0.25
Restaurant	0.1
Health	1.0
Multi-Family High Rise Residential	Included in Lights and Equipment portions of Table 11-1

TABLE 11-5
HVAC SYSTEMS OF PROTOTYPE AND REFERENCE BUILDINGS[1, 2]

BUILDING/SPACE OCCUPANCY	SYSTEM NO. (TABLE 11-7)	REMARKS (TABLE 11-7)
Assembly		
a. Churches (any size)	1	
b. ≤50,000 ft^2 or ≤3 floors	1 or 3	Note 1
c. >50,000 ft^2 or >3 floors	3	
Office		
a. ≤20,000 ft^2	1	
b. >20,000 ft^2 and either ≤3 floors or ≤75,000 ft^2	4	
c. >75,000 ft^2 or >3 floors	5	
Retail		
a. ≤50,000 ft^2	1 or 3	Note 1
b. >50,000 ft^2	4 or 5	Note 1
Warehouse	1	Note 1
Schools		
a. ≤75,000 ft^2 or ≤3 floors	1	
b. >75,000 ft^2 or >3 floors	3	
Hotel/Motel		
a. ≤3 stories	2 or 7	Note 5, 7
b. >3 stories	6	Note 6
Restaurant	1 or 3	Note 1
Health		
a. Nursing Home (any size)	2 or 7	Note 7
b. ≤15,000 ft^2	1	
c. >15,000 ft^2 and ≤50,000 ft^2	4	Note 2
d. >50,000 ft^2	5	Note 2, 3
Multi-Family High Rise Residential >3 stories	7	

[1] Space and Service Water Heating budget calculations shall be made using both electricity and natural gas. The Energy Cost Budget shall be the lower of these two calculations. If natural gas is not available at the rate, electricity and #2 fuel oil shall be used for the budget calculations.

[2] The systems and energy types presented in this Table are not intended as requirements or recommendations for the proposed design. Floor areas below are the total conditioned floor areas for the listed occupancy type in the building. The number of floors indicated below is the total number of occupied floors for the listed occupancy type.

TABLE 11-6
SERVICE HOT WATER QUANTITIES

Building Type	Btu/Person-hour[1]
1. Assembly	215
2. Office	175
3. Retail	135
4. Warehouse	225
5. School	215
6. Hotel/Motel	1110
7. Restaurant	390
8. Health	135
9. Multi-Family High Rise Residential	1700[2]

1. This value is the number to be multiplied by the percentage multipliers of the building profile schedules in Table 11-4. See Table 11-2 for occupancy levels.

2. Total hot water use per dwelling unit for each hour shall be 3400 Btu/h times the multi-family high rise residential building SWH system multiplier from Table 11-3.

TABLE 11-7
HVAC SYSTEM DESCRIPTION FOR PROTOTYPE AND REFERENCE BUILDINGS[1, 2]

HVAC COMPONENT	SYSTEM #1	SYSTEM #2	SYSTEM #3	SYSTEM #4
System Description	Packaged rooftop single zone, one unit per zone	Packaged terminal air conditioner with space heater or heatpump, one heating/ cooling unit per zone	Air handler per zone with central plant	Packaged rooftop VAV w/perimeter reheat
Fan System Design supply circulation rate	Note 9	Note 10	Note 9	Note 9
Supply fan total static pressure	1.3 in. W.C.	N/A	2.0 in. W.C.	3.0 in. W.C.
Combined supply fan, motor, and drive efficiency	40%	N/A	50%	45%
Supply fan control	Constant volume	Fan Cycles with call for heating or cooling	Constant volume	VAV w/forward curved centrifugal fan and variable inlet vanes
Return fan total static pressure	N/A	N/A	0.6 in. W.C.	0.6 in. W.C.
Combined return fan, motor, and drive efficiency	N/A	N/A	25%	25%
Return fan control	N/A	N/A	Constant volume	VAV w/forward curved centrifugal fan and discharge dampers
Cooling System	Direct expansion air cooled	Direct expansion air cooled	Chilled water (Note 11)	Direct expansion air cooled
Heating System	Furnace, heatpump, or electric resistance (Note 8)	Heatpump w/electric resistance auxiliary or air conditioner w/space heater (Note 8)	Hot water (Note 8, 12)	Hot water (Note 12) or electric resistance (Note 8)
Remarks	Drybulb economizer per Section 7.4.3 (barometric relief)	No economizer	Drybulb economizer per Section 7.4.3	Drybulb economizer per Section 7.4.3 Minimum VAV setting per 7.4.3 exception 1. Supply air reset by zone of greatest cooling demand.

Notes:

1. The systems and energy types presented in this Table are not intended as requirements or recommendations for the proposed design.

2. For numbered notes see end of Table 11-7.

TABLE 11-7, (Continued)
HVAC SYSTEM DESCRIPTION FOR PROTOTYPE AND REFERENCE BUILDINGS[1]

HVAC COMPONENT	SYSTEM #5	SYSTEM #6	SYSTEM #7
System Description	Built-up central VAV with perimeter reheat	Four-pipe fan coil per zone with central plant	Water source heat pump
Fan System Design supply circulation rate	Note 9	Note 9	Note 10
Supply fan total static pressure	4.0 in. W.C.	0.5 in. W.C.	0.5 in. W.C.
Combined supply fan, motor, and drive efficiency	55%	25%	25%
Supply fan control	VAV w/air-foil centrifugal fan and AC frequency variable speed drive	Fan cycles w/call for heating or cooling	Fan cycles w/call for heating or cooling
Return fan total static pressure	1.0 in. W.C.	N/A	N/A
Combined return fan, motor, and drive efficiency	30%	N/A	N/A
Return fan control	VAV with air-foil centrifugal fan and AC frequency variable speed drive	N/A	N/A
Cooling System	Chilled water (Note 11)	Chilled water (Note 11)	Closed circuit, centrifugal centrifugal blower type cooling tower sized per Note 11. Circulating pump sized for 2.7 GPM per ton.
Heating System	Hot water (Note 12) or electric resistance (Note 8)	Hot water (Note 12) or electric resistance (Note 8)	Electric or natural draft fossil fuel boiler (Note 8)
Remarks	Drybulb economizer per Section 7.4.3 Minimum VAV setting per Section 7.4.4.3 Supply air reset by zone of greatest cooling demand.	No economizer	Tower fans and boiler cycled to maintain circulating water temperature between 60 and design tower leaving water temperature.

TABLE 11-7
NUMBERED NOTES FOR TABLE 11-7
HVAC SYSTEM DESCRIPTIONS FOR PROTOTYPE AND REFERENCE BUILDINGS

NOTES:

1. For occupancies such as restaurants, assembly and retail which are part of a mixed use building which, according to Table 11-7, includes a central chilled water plant (systems 3, 5, or 6), chilled water system type 3 or 5, as indicated in the Table, shall be used.

2. Constant volume may be used in zones where pressurization relationships must be maintained by code. VAV shall be used in all other areas, in accordance with Section 7.4.4.3.

3. Provide run-around heat recovery systems for all fan systems with minimum outside air intake greater than 75%. Recovery effectiveness shall be 0.60.

4. If a warehouse is not intended to be mechanically cooled, both the Energy Cost Budgets and Design Energy Costs, may be calculated assuming no mechanical cooling.

5. The system listed is for guest rooms only. Areas such as public areas and back-of-house areas shall be served by system 4. Other areas such as offices and retail shall be served by the systems listed in Table 11-7 for these occupancy types.

6. The system listed is for guest rooms only. Areas such as public areas and back-of-house areas shall be served by system 5. Other areas such as offices and retail shall be served by systems listed in Table 11-7 for these occupancy types.

7. System 2 shall be used for the Energy Cost Budget calculation except in areas with design heating outside air temperatures less than 10 ^{o}F.

8. Prototype energy budget cost calculations shall be made using both electricity and natural gas. If natural gas is not available at the site, electricity and #2 fuel oil shall be used. The Energy Cost Budget shall be the lower of these results. Alternately, the Energy Cost Budget may be based on the fuel source that minimizes total operating, maintenance, equipment,

and installation costs for the prototype over the building lifetime. Equipment and installation cost estimates shall be prepared using professionally recognized cost estimating tools, guides, and techniques. The methods of analysis shall conform to those of Subpart A of 10 CFR 436. Energy costs shall be based on actual costs to the building as defined in this Section.

9. Design supply air circulation rate shall be based on a supply air to room air temperature difference of 20 °F. A higher supply air temperature may be used if required to maintain a minimum circulation rate of 4.5 air changes per hour or 15 cfm per person at design conditions to each zone served by the system. If return fans are specified, they shall be sized from the supply fan capacity less the required minimum ventilation with outside air, or 75% of the supply air capacity, whichever is larger. Except where noted, supply and return fans shall be operated continuously during occupied hours.

10. Fan Energy When included in the efficiency rating of the unit as defined in Section 7.4.4.3 need not be modeled explicitly for this system. The fan shall cycle with calls for heating or cooling.

11. Chilled water systems shall be modeled using a reciprocating chiller for systems with total cooling capacities less than 175 tons, and centrifugal chillers for systems with cooling capacities of 175 tons or greater. For systems with cooling of 600 tons or more, the Energy Cost Budget shall be calculated using two centrifugal chillers lead/lag controlled. Chilled water pumps shall be sized using a 12 °F temperature rise, from 44 °F to 56 °F, operating at 75 feet of head and and 65% combined impeller and motor efficiency. Condenser water pumps shall be sized using a 10 °F temperature rise, operating at 60 feet of head and 60% combined impeller and motor efficiency. The cooling tower shall be an open circuit, centrifugal blower type sized for the larger of 85 °F leaving water temperature or 10 °F approach to design wetbulb temperature. The tower shall be controlled to provide a 65 °F leaving water temperature whenever weather conditions permit, floating up to design leaving water temperature at design conditions. Chilled water supply temperature shall be reset in accordance with Section 7.4.6.2.

12. Hot water system shall include a natural draft fossil fuel or electric boiler per Note 8. The hot water pump shall be sized based on a 30 °F temperature drop, for 180 °F to 150 °F, operating at 60 feet of head and a combined impeller and motor efficiency of 60%. Hot water supply temperature shall be reset in accordance with Section 7.4.6.2.

TABLE 11-8
THERMOSTAT SETTINGS FOR MULTI-FAMILY HIGH-RISE BUILDINGS

TIME OF DAY	SINGLE ZONE DWELLING UNIT		TWO ZONE DWELLING UNIT			
			BEDROOMS/BATHROOMS		OTHER ROOMS	
	HEAT	COOL	HEAT	COOL	HEAT	COOL
Midnight - 6 a.m.	60	78	60	78	60	85
6 a.m. - 9 a.m.	70	78	70	78	70	78
9 a.m. - 5 p.m.	70	78	60	85	70	78
5 p.m. - 11 p.m.	70	78	70	78	70	78
11 p.m. - Midnight	60	78	60	78	60	78

§ 435.112 Building energy compliance alternative.

12.1 General

12.1 This section provides an alternative path for compliance with the standards that allow for greater flexibility in the design of energy efficient buildings using an annual energy target method. This path, as does the path used in section 11.0, provides an opportunity for the use of innovative designs, materials, and equipment such as daylighting, passive solar heating, heat recovery, and thermal storage as well as other applications of off-peak electrical energy where they cannot be adequately evaluated by the prescriptive or system performance methods found in sections 3.4, 3.5, 5.4, 5.5, 7.4., and 9.4.

12.1.2 The Building Energy Use Budget Target alternative may be used as an option to the Building Energy Cost Budget method in section 11.0 and is to be used in lieu of the prescriptive and system performance methods and in conjunction with sections 3.3, 4.3, 5.3, 6.3, 7.3, 8.3, 9.3 and 10.3.

12.1.3 Compliance under this section is demonstrated by showing that the calculated annual energy usage for the Proposed Design is less than or equal to a calculated Energy Use Budget. (See Figure 12–1). A life-cycle cost economic analysis is required to evaluate alternative fuel sources and energy reduction strategies. The procedures in this chapter are intended only for establishing design compliance, and are not intended to be used either to predict, document or verify annual energy consumption or annual energy costs.